

(1) Bump formation

According to the method of forming a bump with plating (third prior art), a special bump forming process is required to be performed by the semiconductor manufacturer, and therefore, the bump formation can be formed only by the limited manufacturers. However, according to the aforementioned embodiments of the present invention, IC chips for general-purpose wire bonding can be employed by means of a wire bonding device, and IC chips can easily be available. The reason why the IC chips for general-purpose wire bonding can be employed is that bumps can be formed on ordinary IC pads on which Al pads are formed by means of a wire bonding device or a bump bonding apparatus so long as the IC chips are for wire bonding use.

On the other hand, in order to form plating bumps by the method of forming bumps with plating (third prior art), there are the processes of forming barrier metals of Ti, Cu, Cr, or the like on Al pads, applying a resist by spin coating, and forming holes by exposure only in the bump forming portions. The bumps are formed by electrifying this and plating the hole portions with Au or the like. Therefore, a large-scale plating apparatus and a waste disposal plant of hazardous substances such as cyanides are needed to form the plating bumps, and therefore, it is practically impossible to do so in a factory that carries

out the ordinary assembly processes.

Moreover, the bump leveling for stabilizing the amount of transfer of the adhesive in an unstable transfer process of transfer such as the transfer of the conductive adhesive becomes unnecessary by comparison with the method of the first prior art, and the leveling device for such a leveling process becomes unnecessary. The above is because it is not required to preliminarily level only the bumps since the bumps are crushed on the electrodes of the board while pressurizing the bumps.

Moreover, if the following method is adopted, bonding of high reliability can also be achieved even when bump(s) 103 is bonded to the electrode(s) 5 of the circuit board 4 as mounted with a shift. That is, when forming the bumps 3 on the IC chip 1, a gold ball 96a is formed by subjecting the gold wire to an electric spark similarly to the wire bonding. Next, a ball 96a of a Φ d-Bump of the diameter denoted by 95a is formed, and a bump 103 is formed on the electrode 2 of the IC chip 1 by supersonic waves and thermocompression-bonding by means of a capillary 193 designed so that a chamfer diameter ϕ D denoted by 93a of the capillary 193 whose chamfer angle θ_c is not greater than 100° becomes one-half to three-fourths the gold ball diameter d-Bump and no flat portion is provided in the portion to be brought in contact with the gold ball 96a of

a capillary 193 in terms of tip shape. By using the capillary 193 that has the above-mentioned configuration, approximately conically tipped bumps 103 as shown in Fig. 47B can be formed on the electrodes 2 of the IC chip 1.

5 Even when the bumps 103 formed by the aforementioned method are mounted on the electrodes 5 of the circuit board 4 while being shifted by a dimension Z as shown in Fig. 48C, the bumps 103 can partially come in contact with the electrodes 5 of the board 4 without fail so long as the

10 shift is not greater than half the outside diameter of the bump 103 since the bumps 103 have the approximately conically tipped shape. The so-called base 3g of a width dimension d of the bump 3 partially comes in contact with the electrode in Fig. 48D of the conventional bump 3.

15 However, this contact is mere partial contact, leading to unstable bonding. If this is subjected to a thermal shock test or reflow, the bonded portion becomes open. The present invention can eliminate the above-mentioned unstable bonding and provide the bonding of high production

20 yield and high reliability.

(2) Bonding of IC chip to circuit board

According to the method of the second prior art, the connection resistance has been depended on the number of conductive particles that exist between the bump and the

25 electrode of the circuit board. However, according to the